

ANNUAL POLIOMYELITIS
SUMMARY - 1970

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SURVEILLANCE

POLIOMYELITIS

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
HEALTH SERVICES AND MENTAL HEALTH ADMINISTRATION

PREFACE

Summarized in this report is information received from state health departments, university investigators, virology laboratories, and other pertinent sources, domestic and foreign. Much of the information is preliminary. It is intended primarily for the use of those with responsibility for disease control activities. Anyone desiring to quote this report should contact the original investigator for confirmation and interpretation.

Contributions to this report are most welcome. Please address:

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*Until June 1970

**Until June 1971

I. SUMMARY

Thirty-two cases of paralytic poliomyelitis, with two deaths, were reported in the United States for 1970. Cases in 1970 were widely distributed throughout the country, although there was a relative concentration in southern Texas. Most of the cases occurred in unimmunized children below the age of 10; one case occurred in an adult (age 48). Paralytic disease was predominantly associated with poliovirus 1 infection. In one case the patient had close association with a recently vaccinated individual. None of the persons who contracted paralytic polio in 1970 had received an adequate course of poliomyelitis vaccination. The National Immunization Survey in 1970 showed a decrease of approximately 8 percent in the history of adequate immunization against poliomyelitis between 1965 and 1970 in 1-14 year olds.

II. EPIDEMIOLOGY OF POLIOMYELITIS IN 1970

This 16th annual report of poliomyelitis surveillance, published by the Neurotropic Diseases Unit of the Center for Disease Control (CDC), summarizes selected epidemiologic and laboratory characteristics of the reported cases of poliomyelitis for the year 1970. These data are based upon official reports from the states to the Epidemiology Program, CDC.

A. Total Poll of Poliomyelitis Disease, 1970

1. Paralytic Disease. In 1970, the "best available paralytic poliomyelitis case count" was 32 cases. This designation, utilized since 1958 as the best available representation of the number of cases of paralytic illness of poliovirus etiology, includes those clinically and epidemiologically compatible cases known to have residual paralysis at 60 days, plus those cases reported initially as paralytic poliomyelitis for which no 60-day report on residual paralysis was available (categories A and B of Table 1). Limitation of the summary count to those cases with proved residual paralysis permits exclusion of cases with more transient weakness possibly due to echovirus, Coxsackie virus, or other viruses, although not proven as such. Not all of the paralytic cases listed have laboratory documentation. Recognizing the limitations of the "best available paralytic poliomyelitis case count," the term is again used this year to permit useful and uniform comparison of the 1970 total with data from previous years. For 1970, a 60-day follow up was available for 27 of the 32 reported paralytic cases. No state reports were received on cases of non-paralytic polio, although laboratory isolations of poliovirus from cases of aseptic meningitis have been reported by various laboratories (see Table 13).

B. Epidemiology of Paralytic Cases, 1970

1. Characteristics of the Cases. The total number of cases included in the "best available paralytic case count" has declined since this number was first tabulated in 1958 (Figure 1). The total of 32 cases reported for 1970 represents a slight increase over 1969, which had the lowest annual total (19 cases) reported to the CDC since initiation of surveillance in 1955.

In 1970 cases occurred throughout the year with the majority occurring in May, June and August (Figure 2). The classic summer-fall peak, last observed in the early 1960's (Figure 3), has not persisted.

Table 1

POLIOMYELITIS CASES REPORTED TO CDC IN 1970

| | |
|---|-------|
| A. Paralytic poliomyelitis cases with residual paralysis at 60 days | 27 |
| B. Paralytic polio cases without report on residual paralysis | 4 |
| C. Paralytic polio cases without residual paralysis | 1 |
| D. Aseptic meningitis due to poliovirus (non-paralytic polio) | 0 |
| | <hr/> |
| | 32 |

Figure 1 "BEST AVAILABLE PARALYTIC POLIOMYELITIS CASE COUNT," BY YEAR, UNITED STATES, 1958-1970

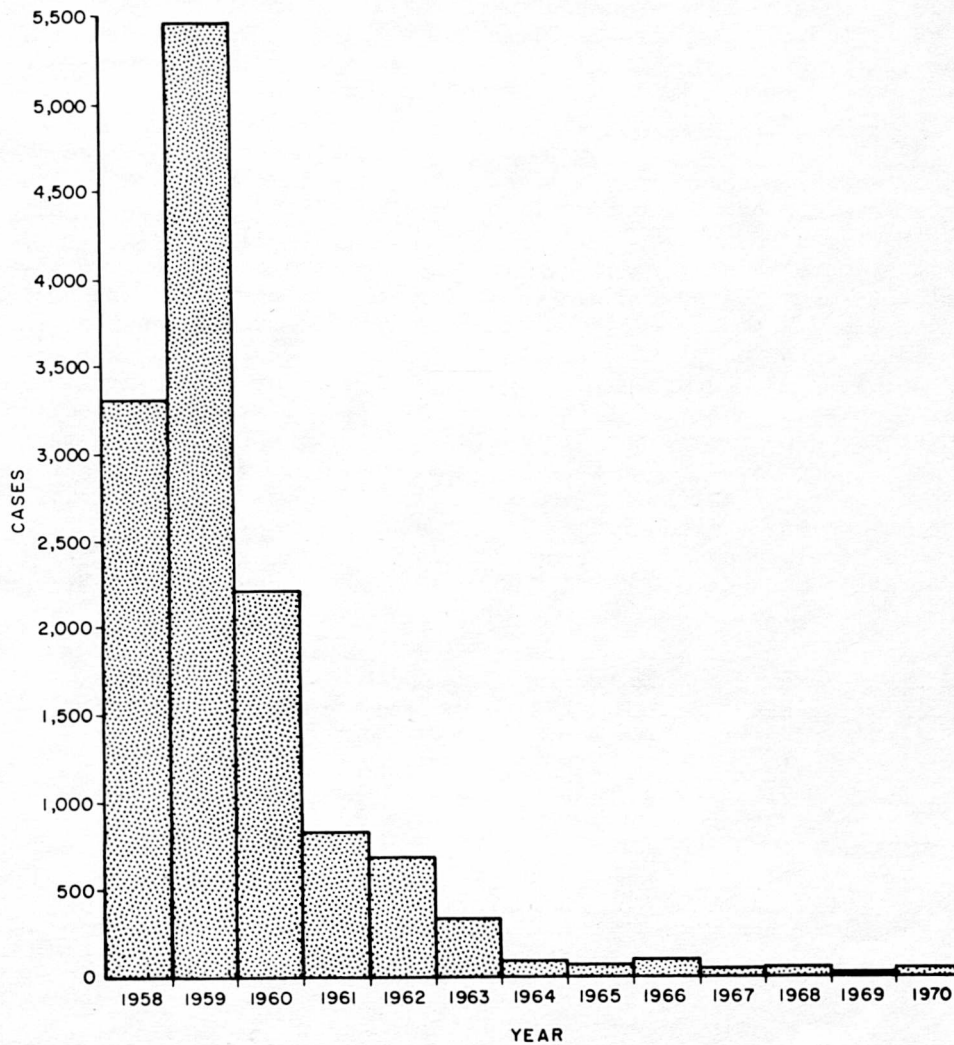


Figure 2 32 REPORTED CASES OF PARALYTIC POLIOMYELITIS,
BY MONTH OF ONSET, UNITED STATES, 1970

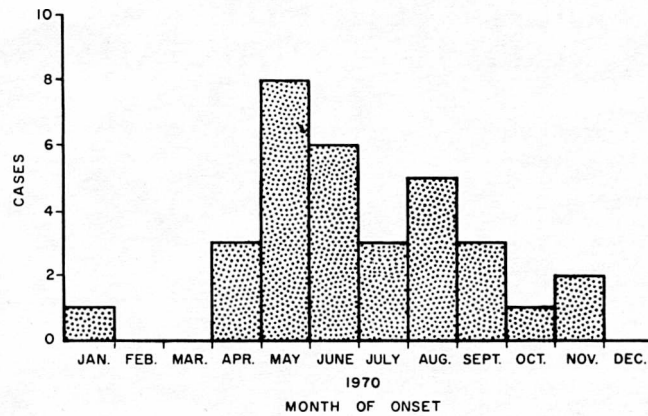
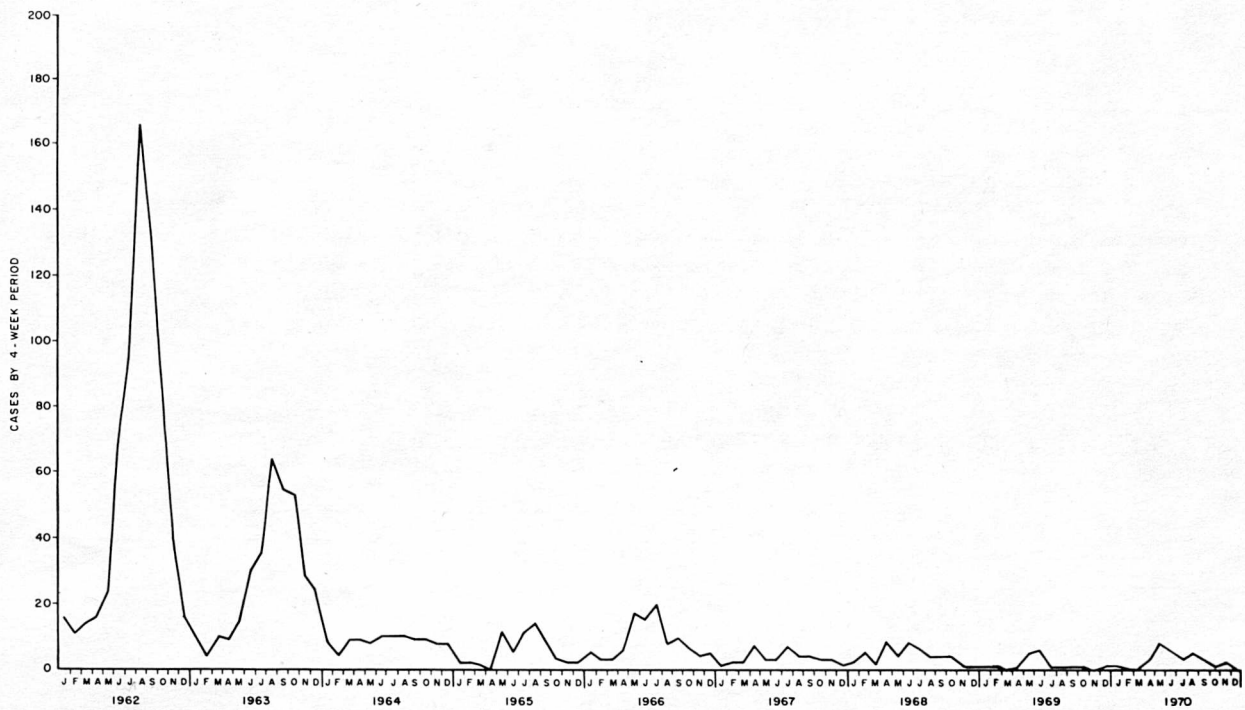
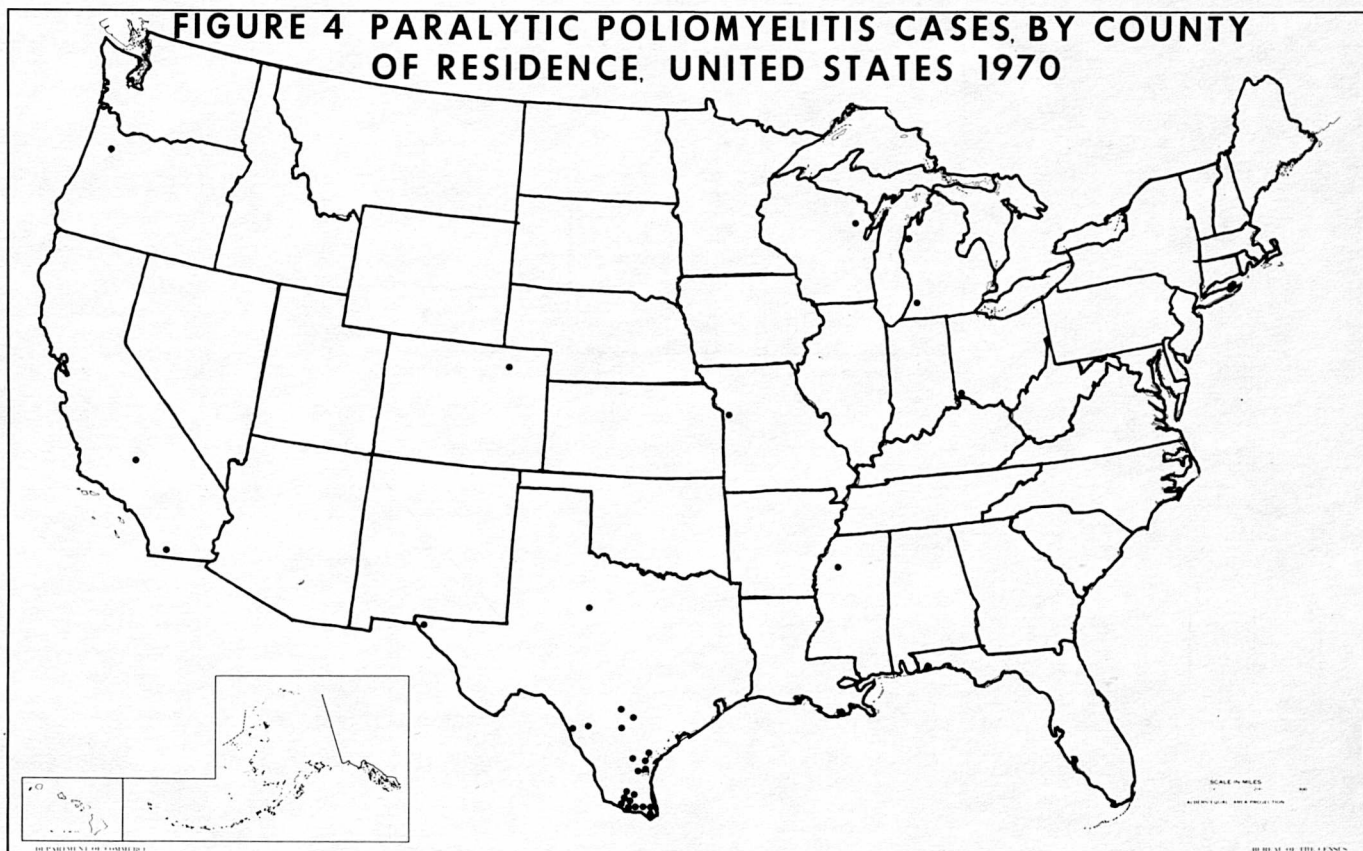


Figure 3 PARALYTIC POLIOMYELITIS CASES BY MONTH OF ONSET, UNITED STATES, 1962-1970



Geographical distribution of cases by county of residence (Figure 4) shows that 13 of the cases were from southeastern Texas; seven of these were reported from Hidalgo County and three from Cameron County--the greatest number of cases from these two counties since 1966. The other cases were widely distributed throughout the United States, with California and Michigan the only states reporting more than one paralytic case.



Residual paralysis in the cases parallels that reported from the past 3 years (Table 2). Two deaths attributed to paralytic poliomyelitis were reported for 1970, compared with no deaths for 1969. Comparison of age distribution for the past 10 years is presented in Table 3. In 1970, all cases, with two exceptions, occurred in pre-schoolers. This differs from findings of previous years, but reflects to some degree a bias due to the large number of cases from Texas.

Table 2
PARALYTIC POLIOMYELITIS
BY STATUS OF RESIDUAL PARALYSIS AT 60 DAYS, 1967-70

| Status | 1967 | | 1968 | | 1969 | | 1970 | |
|----------------------|-------|-----|-------|-----|-------|-----|-------|-----|
| | Cases | % | Cases | % | Cases | % | Cases | % |
| Death | 6 | 15 | 5 | 10 | 0 | 0 | 2 | 6 |
| Severe residual | 9 | 22 | 8 | 17 | 4 | 22 | 1 | 3 |
| Significant residual | 12 | 29 | 18 | 38 | 11 | 58 | 21 | 66 |
| Minor residual | 10 | 24 | 10 | 21 | 3 | 15 | 3 | 10 |
| Unknown | 4 | 10 | 7 | 14 | 1 | 5 | 5 | 15 |
| Total | 41 | 100 | 48 | 100 | 19 | 100 | 32 | 100 |

Table 3

PARALYTIC POLIOMYELITIS CASES, BY AGE GROUP, 1961-70

| | 1961 | | 1962 | | 1963 | | 1964 | | 1965 | | 1966 | | 1967 | | 1968 | | 1969 | | 1970 | |
|-------|------|----|------|----|------|----|------|----|------|----|------|----|------|----|------|----|------|----|------|----|
| | # | % | # | % | # | % | # | % | # | % | # | % | # | % | # | % | # | % | # | % |
| 0-4 | 319 | 38 | 338 | 49 | 165 | 49 | 38 | 42 | 31 | 51 | 79 | 77 | 25 | 61 | 31 | 65 | 9 | 46 | 29 | 92 |
| 5-9 | 184 | 22 | 139 | 20 | 60 | 18 | 16 | 17 | 10 | 16 | 10 | 10 | 2 | 5 | 3 | 6 | 2 | 11 | 2 | 5 |
| 10-14 | 79 | 10 | 70 | 10 | 38 | 11 | 7 | 8 | 7 | 11 | 3 | 3 | 0 | | 4 | 9 | 1 | 5 | 0 | |
| 15-19 | 39 | 5 | 26 | 4 | 15 | 4 | 8 | 9 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 4 | 22 | 0 | |
| 20-29 | 106 | 13 | 52 | 8 | 24 | 7 | 7 | 4 | 4 | 7 | 3 | 3 | 4 | 10 | 4 | 8 | 0 | | 0 | |
| 30-39 | 71 | 9 | 36 | 5 | 18 | 5 | 7 | 8 | 3 | 5 | 5 | 5 | 7 | 17 | 2 | 4 | 2 | 11 | | |
| 40+ | 30 | 3 | 22 | 3 | 8 | 2 | 11 | 12 | 4 | 7 | 1 | 1 | 2 | 5 | 3 | 6 | 1 | 5 | 1 | 2 |
| Unkn. | 1 | <1 | 8 | 1 | 8 | 2 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | |
| TOTAL | 829 | | 691 | | 336 | | 91 | | 61 | | 102 | | 41 | | 48 | | 19 | | 32 | |

History of recent travel to poliomyelitis endemic areas was obtained for four of the paralytic cases reported for 1970. The two patients had traveled to Mexico within 30 days of the onset of symptoms. The other two cases, both in patients of Latin extraction, had traveled from Texas to another state where polio was diagnosed within 30 days. In addition, in nine of the Texas cases the patients had traveled to the Rio Grande Valley area within 30 days of onset of symptoms.

2. "Type Specific Etiology" of Poliovirus Associated with 1970 Paralytic Cases. The basis for established a type specific etiology for the 1970 paralytic cases is summarized in Table 4. Of the 32 cases, 11 were confirmed by both viral isolation and diagnostic (fourfold) rise or fall in serotype-specific antibody titer, while two cases were confirmed by diagnostic titer rise alone. Although the presence of an enterovirus in the alimentary tract does not constitute proof of an etiologic role, isolation of poliovirus from throat washings or throat in the context of compatible illness and absence of evidence for another etiology has been accepted by the respective states as adequate documentation of etiology (and included in this summary as the probable agents). Thus, 19 other cases were designated as to type on the basis of viral isolation only. In no instance was a diagnosis of paralytic poliomyelitis based on clinical criteria alone (without laboratory confirmation). In two cases, another enterovirus (echo 2 and 7) and in one case two polioviruses (polio 1 and 2) were isolated. Final categorization by "etiology" was based on either serologic studies or epidemiologic data. Comparison of "etiologic" poliovirus types for 1966-1970 (the only years in which this method of definition has been used) shows that type 1 poliovirus comprises a larger percentage of all cases in 1970 than was true for the preceding 4 years (Table 5). Tabulation of the 32 paralytic cases by age group and "etiologic" virus type (Table 6) shows that persons with type 1 poliovirus predominantly were under 5 years of age. Classification of all reported poliovirus illnesses by "etiologic" type, presence, and persistence of paralytic status shows no correlation between a given poliovirus and the severity of illness (Table 7). Furthermore, no significant correlation existed between extent of residual paralysis and the poliovirus type, either for the 1970 cases alone or for the combined totals of the years 1966-1970 (Table 8).

Table 4
PARALYTIC POLIOMYELITIS
BY DESIGNATION OF "ETIOLOGIC" POLIOVIRUS TYPE, 1970

| | <u>Poliovirus Type 1</u> | <u>Poliovirus Type 2</u> | <u>Poliovirus Type 3</u> | <u>Unknown</u> | <u>Total</u> |
|---|------------------------------|------------------------------|------------------------------|----------------|--------------|
| Viral isolation and diagnostic serology | 10 | 0 | 1 | 0 | 11 |
| Diagnostic serology as only laboratory confirmation | 2 | 0 | 0 | 0 | 2 |
| Viral isolation as only laboratory support | 15 | 4 | 0 | 0 | 19 |
| Diagnosis made on clinical and epidemiological basis only-- no evaluation of etiology possible | 0 | 0 | 0 | 0 | 0 |
| Total | 27 | 4 | 1 | 0 | 32 |

Table 5
PARALYTIC POLIOMYELITIS CASES
BY "ETIOLOGIC" POLIOVIRUS TYPES, 1966-70

| | <u>Type 1</u> | | <u>Type 2</u> | | <u>Type 3</u> | | <u>Unknown</u> | | <u>Total Cases</u> |
|------|---------------|----------|---------------|----------|---------------|----------|----------------|----------|--------------------|
| | <u>No.</u> | <u>%</u> | <u>No.</u> | <u>%</u> | <u>No.</u> | <u>%</u> | <u>No.</u> | <u>%</u> | |
| 1966 | 60 | 59 | 13 | 13 | 6 | 6 | 23 | 22 | 102 |
| 1967 | 18 | 44 | 8 | 19 | 7 | 18 | 8 | 19 | 41 |
| 1968 | 27 | 56 | 7 | 15 | 4 | 8 | 10 | 21 | 48 |
| 1969 | 6 | 32 | 5 | 26 | 4 | 21 | 4 | 21 | 19 |
| 1970 | 27 | 84 | 4 | 13 | 1 | 3 | 0 | 0 | 32 |

Table 6
PARALYTIC POLIOMYELITIS CASES
BY AGE GROUP AND "ETIOLOGIC" POLIOVIRUS TYPE, 1970

| <u>Age Group</u> | <u>Poliovirus Type</u> | | | | <u>Total</u> |
|------------------|------------------------|----------|----------|----------------|--------------|
| | <u>1</u> | <u>2</u> | <u>3</u> | <u>Unknown</u> | |
| 0-4 | 25 | 4 | 1 | 0 | 30 |
| 5-9 | 1 | 0 | 0 | 0 | 1 |
| 10-39 | 0 | 0 | 0 | 0 | 0 |
| 40+ | 1 | 0 | 0 | 0 | 1 |
| Total | 27 | 4 | 1 | 0 | 32 |

Table 7
CLASSIFICATION OF POLIOVIRUS ILLNESS
BY NATURE OF INVOLVEMENT AND "ETIOLOGIC" POLIOVIRUS TYPE

| | <u>1</u> | <u>2</u> | <u>3</u> | <u>Unknown</u> | <u>Total</u> |
|---|----------|----------|----------|----------------|--------------|
| I. Paralytic with residual | 23 | 2 | 1 | 0 | 26 |
| II. Paralytic without follow-up | 4 | 2 | 0 | 0 | 6 |
| III. Aseptic meningitis due to poliovirus ("non-paralytic poliomyelitis") | 0 | 0 | 0 | 0 | 0 |
| Total | 27 | 4 | 1 | 0 | 32 |

Table 8
PARALYTIC POLIOMYELITIS
BY SEVERITY OF RESIDUAL PARALYSIS AT 60 DAYS
AND "ETIOLOGIC" POLIOVIRUS TYPE, 1966-70

| | Poliovirus Type | | | | |
|----------------------|-----------------|----------|----------|----------|-----------|
| | 1 | 2 | 3 | Unknown | Total |
| <u>1966-69</u> | | | | | |
| Death | 6(5%) | 2(6%) | 5(24%) | 5(11%) | 18(9%) |
| Severe residual | 18(16%) | 5(16%) | 5(24%) | 6(13%) | 34(16%) |
| Significant residual | 51(46%) | 18(56%) | 6(28%) | 22(49%) | 97(46%) |
| Minor residual | 24(22%) | 8(22%) | 5(24%) | 10(22%) | 47(22%) |
| Unknown residual | 12(11%) | 0 | 0 | 2(5) | 14(7%) |
| Total | 111(100%) | 33(100%) | 21(100%) | 45(100%) | 210(100%) |
| <u>1966-70</u> | | | | | |
| Death | 8(6%) | 2(5%) | 5(23%) | 5(11%) | 20(9%) |
| Severe residual | 19(14%) | 5(14%) | 5(23%) | 6(13%) | 35(14%) |
| Significant residual | 67(49%) | 20(54%) | 7(31%) | 22(49%) | 116(48%) |
| Minor residual | 28(20%) | 8(22%) | 5(23%) | 10(22%) | 51(21%) |
| Unknown residual | 15(11%) | 2(5%) | 0 | 2(5%) | 19(8%) |
| Total | 137(100%) | 37(100%) | 22(100%) | 45(100%) | 241(100%) |
| <u>1970</u> | | | | | |
| Death | 2(7%) | 0 | 0 | 0 | 2(7%) |
| Severe residual | 1(4%) | 0 | 0 | 0 | 4(4%) |
| Significant residual | 16(59%) | 2(50%) | 1(100%) | 0 | 19(59%) |
| Minor residual | 4(15%) | 0 | 0 | 0 | 4(13%) |
| Unknown residual | 4(15%) | 2(50%) | 0 | 0 | 6(17%) |
| Total | 27(100%) | 4(100%) | 1(100%) | 0 | 32(100%) |

3. Viral Isolations Associated with 1970 Paralytic Poliomyelitis Cases. The number of cases in which viral isolation was attempted and the number in which isolation attempts were successful for the period 1960-1970 appear in Table 9. Samples for viral isolation were obtained in a higher percentage of cases in 1970 than in all of the previous 9 years. This probably reflects an increasing utilization of laboratory testing to confirm clinical impressions. For 1970, 29 of the 30 isolates were obtained from stool specimens, and one was obtained from a throat swab. No isolations were made from cerebrospinal fluid (CSF). A comparison of the frequency of isolation of each poliovirus type from the annual total of paralytic cases is shown in Table 10 for the years 1960-1970. While consistent with the distribution observed in previous years, the marked contribution of type 1 poliovirus to paralytic disease in 1970, as demonstrated by viral isolation, represents a striking change from 1969 in which the three types of virus were isolated from paralytic cases with almost equal frequency.

C. Association of Immunization with Paralytic Poliomyelitis

1. Paralytic Poliomyelitis and Recent Vaccine Recipients. In July 1964 the Surgeon General's Special Advisory Committee on all poliomyelitis vaccine reviewed all cases of paralytic disease consistent with poliomyelitis that had occurred within 30 days following receipt of oral poliovaccine (OPV). At that time, 57 cases were judged to be "compatible" with vaccine association by virtue of meeting the following criteria:

- a. Onset of illness between 4 and 30 days following feeding of the specific vaccine, plus onset of paralysis not sooner than 6 days after the feeding.
- b. Significant residual lower motor neuron paralysis.
- c. Laboratory data not inconsistent with respect to multiplication of the vaccine virus fed.
- d. No evidence of other motor neuron disease, definite sensory loss, or progression (or recurrence) of paralytic disease 1 month or more after onset.

Table 9
PARALYTIC POLIOMYELITIS
BY NUMBER OF SPECIMENS SUBMITTED AND RESULTS
OF VIRUS ISOLATION ATTEMPTS BY YEAR, 1960-70

| | Best Available Paralytic Case Count | Cases with Specimens Submitted for Isolation | | Cases With Poliovirus Isolated | | % of Specimens Submitted in Which Isolation Successful |
|------|---|---|------|-----------------------------------|------------|---|
| | | No. | % | No. | % of Cases | |
| 1960 | 2,218 | 1,072 | 48.3 | 825 | 37.2 | 77% |
| 1961 | 829 | 481 | 58.0 | 382 | 46.1 | 79% |
| 1962 | 691 | 472 | 68.3 | 408 | 59.0 | 86% |
| 1963 | 336 | 242 | 72.0 | 197 | 58.6 | 81% |
| 1964 | 91 | 77 | 84.6 | 51 | 56.0 | 66% |
| 1965 | 61 | 50 | 81.9 | 38 | 62.3 | 76% |
| 1966 | 103 | 82 | 79.6 | 74 | 71.8 | 90% |
| 1967 | 40 | 31 | 77.5 | 29 | 72.5 | 93% |
| 1968 | 48 | 39 | 81.2 | 35 | 72.9 | 90% |
| 1969 | 19 | 16 | 84.2 | 14 | 73.6 | 87.5% |
| 1970 | 32 | 32 | 100 | 30 | 93.8 | 93.8% |

Table 10
PARALYTIC POLIOMYELITIS CASES
BY TYPE OF POLIOVIRUS ISOLATED
AND PERCENTAGE OF TOTAL CASES OF YEAR, 1960-1970

| Year | Type | Number of Isolates | | | | Percentage | | |
|------|------|--------------------|----|-----|---------|------------|------|------|
| | | 1 | 2 | 3 | Unknown | 1 | 2 | 3 |
| 1960 | | 603 | 1 | 219 | 2 | 73.1 | 0.1 | 26.5 |
| 1961 | | 231 | 6 | 145 | 0 | 60.5 | 1.6 | 37.9 |
| 1962 | | 300 | 8 | 100 | 0 | 73.5 | 2.0 | 24.5 |
| 1963 | | 160 | 6 | 31 | 0 | 81.2 | 3.0 | 15.7 |
| 1964 | | 21 | 6 | 24 | 0 | 41.1 | 11.8 | 47.0 |
| 1965 | | 19 | 8 | 11 | 1 | 50.0 | 21.1 | 28.9 |
| 1966 | | 55 | 13 | 6 | 1 | 74.3 | 17.6 | 8.1 |
| 1967 | | 16 | 6 | 7 | 0 | 55.2 | 20.7 | 24.1 |
| 1968 | | 25 | 7 | 3 | 0 | 71.4 | 20.0 | 8.6 |
| 1969 | | 5 | 5 | 4 | 0 | 34.6 | 34.6 | 30.8 |
| 1970 | | 25 | 4 | 1 | 0 | 83.2 | 13.4 | 3.4 |

The cases reported since 1964 have not been formally reviewed by an advisory committee. However, the Neurotropic Diseases Unit had continued to use the above criteria to determine whether such a case is consistent with vaccine association, recognizing that such association does not necessarily imply a causal relationship. The cases fulfilling the above criteria are termed "recipient, vaccine-like" cases. There have been 15 such cases of this type for the period July 1964 through December 1969. In 1970 no cases of this type were reported to CDC. This may be related to the greater use of trivalent oral poliovaccine (TOPV), which in the past has seemed less likely to produce cases of this type. In four cases, patients received one dose of TOPV within 1 month of the development of paralytic disease, but subsequent laboratory data was interpreted by the state involved to be inconsistent with the multiplication of the vaccine virus fed.

2. Paralytic Poliomyelitis in Contacts of Recent Vaccine Recipients. In addition to the group noted above, it has been recognized that cases of paralytic

illness have also occurred in persons with a history of close relationships to recent OPV recipients. These have been termed "contact vaccine-association" cases, denoting paralytic disease in a contact of a vaccinee. In 1970, one case of paralytic illness occurred in a family member of a vaccine recipient. In this instance, the vaccine given to the contact was trivalent oral poliovaccine (TOPV). This case is described below. Paralytic disease occurred in a 4-year-old Oregon girl 26 days after her brother had received TOPV. The patient had involvement Oregon girl 26 days after her brother had received TOPV. The patient had involvement of both upper and lower extremities following premonitory malaise. Poliovirus type 3 was grown from a stool culture and exhibited vaccine-like antigenic and temperature characteristics (T +39.5 and T +40.1 C.). Serum neutralization studies revealed polio 3 antisera levels of 1:20 1 week after symptom onset, rising to 1:160 5 weeks after onset. Follow-up evaluation at 60 days revealed residual left arm and leg weakness.

3. "Vaccine Failures". A "vaccine failure" is presently defined as paralytic disease attributed to poliovirus infection occurring in an individual having previously received an "adequate immunization series." As defined by the Advisory Committee on Immunization Practices (ACIP), an "adequate" series consists of four or more doses of inactivated poliovirus vaccine (IPV) or three primary doses of either monovalent oral poliovaccine (MOPV) or TOPV and a booster "dose" of TOPV. only four of the 32 reported paralytic cases for 1970 had previously received oral poliovaccine (OPV) prior to onset of illness (Table 11). These four cases bring to 69 the total number of persons, since 1963, reported to have received at least one dose of OPV prior to onset of paralytic poliomyelitis. One patient received three doses of IPV 6 years prior to onset of symptoms.

Poliovirus types 1 and 3 have been most frequently isolated from these patients. Nineteen patient received at least one dose of TOPV, but only one of these had received adequate TOPV. As noted in the 1969 surveillance report, this child had been shown to be hypogammaglobulinemic.

Table 11
PARALYTIC POLIOMYELITIS
BY IMMUNIZATION STATUS* OF ALL WITH HISTORY
OF AT LEAST ONE IMMUNIZATION, 1970

| <u>State</u> | <u>Age</u> | <u>Sex</u> | <u>OPV</u> | | <u>Year</u> | | <u>Year</u> | | <u>Virus and Type</u> | <u>Disability</u> |
|--------------|------------|------------|------------|-------------|------------------|------------|------------------|--|---------------------------|-------------------|
| | | | <u>No.</u> | <u>Type</u> | <u>Last Dose</u> | <u>IPV</u> | <u>Last Dose</u> | | | |
| Mich. | 1-1/2 | F | 1 | OPV | 6/70 | | | | I Wild, +/- | Significant |
| Texas | 14 Mos | M | 1 | OPV | 10/70 | | | | I | Unknown |
| | 8 Mos | F | 1 | OPV | 5/70 | | | | I Wild, +/+ | Significant |
| | 11 Mos | F | 1 | OPV | 4/70 | | | | I Wild, +/+ | Severe |
| Calif. | 7 | F | | | | 3 | 1964 | | I Wild | Minimal |

*All with history of at least one dose

III. LABORATORY STUDIES OF POLIOMYELITIS, 1970

A. Characterization of Poliovirus Isolation, 1970

Laboratory techniques have been employed to differentiate "vaccine-like" from "nonvaccine-like" (wild) strains of virus isolates. One of these tests, a modified Wecker intratypic serodifferentiation test, is based upon certain antigenic characteristics of the virus strains. Another test, the "temperature marker" ("T" marker), is based upon comparison of viral replication at different temperatures. In general, strains of poliovirus types 1 and 2 that are antigenically "vaccine-like" are usually associated with negative "T" markers, while this association is seen less frequently with poliovirus type 3. Occasionally, however, isolates which are antigenically "vaccine-like" may have intermediate or positive "T" markers and vice versa. This has been an increasingly common finding in our laboratory--suggesting the need for careful antigenic analysis of all polio isolates in the future. Thus, these tests do not definitely establish the origin of the virus isolated, and

furthermore do not in any way indicate the neurovirulence of the isolated virus. Laboratory characterization studies were performed by the CDC Enteric Virology Unit on poliovirus isolates from 18 of the 32 patients with paralytic poliomyelitis reported in 1970 (Table 12). Of the 18, three had a history of prior immunization and one had history of contact with a recent vaccine recipient. Antigenic characterization was described as "nonvaccine-like" for 10 of the 14 patients for whom no recent vaccine contact or immunization was known.

Table 12
CHARACTERIZATION OF VIRAL ISOLATES FROM 18 OF 32 CASES
OF PARALYTIC POLIOMYELITIS REPORTED IN 1970

| State | Age | Prior | | Recent OPV Contact | Polio Type | Characterization | | |
|--------|---------|-------|-----|-----------------------|---------------|------------------|--------|-----------|
| | | OPV | IPV | | | Genetic | T39/40 | Antigenic |
| Texas | 1 | | | No | I | Wild | +/- | |
| | *8 Mos | 1 | | No | I | Wild | +/+ | |
| | 8 Mos | | | No | I | Wild | +/+ | |
| | 11 Mos | | | No | I | Wild | +/+ | |
| | *11 Mos | 1 | | No | I | Wild | +/+ | |
| | 1 | | | No | I | Wild | +/+ | |
| | 5 Mos | | | No | I | Wild | +/+ | |
| | 1 | | | No | I | Wild | +/+ | |
| | 1-1/2 | | | No | I | Wild | +/+ | |
| | 4 | | | No | I | Wild | +/+ | |
| | 7 Mos | | | No | I | Wild | +/+ | |
| Mo. | 5 | | | No | II | Vaccine | +/- | |
| Wisc. | 2 | | | No | II | Vaccine | +/- | |
| Miss. | 11 Mos | | | No | II | Vaccine | -/- | |
| Mich. | *1-1/2 | 1 | | No | I | Wild | +/- | |
| Oreg. | *4 | | | Yes | III | Vaccine | +/+ | |
| Colo. | 1-1/2 | | | No | II | Vaccine | +/- | |
| Calif. | 7 | | 3 | No | I | Wild | | |

*Recent contact or immunization

B. Poliovirus Isolations, 1970

Reports of at least one poliovirus isolation were received from 12 reporting states for 1970 (Table 13); 46 were reported in association with cases of paralytic disease. An additional nine isolations from patients with aseptic meningitis were reported as nonparalytic polio. An additional 19 were incidental poliovirus isolations obtained from individuals with no illness, or from patients whose illness were not attributed to poliovirus infection. In the majority of these cases, the patients were known to have a history of recent exposure to oral poliovaccine. The number of "incidental" poliovirus isolations reported by a given state does not indicate the relative presence or absence of poliovirus activity within the state, but rather may reflect differences in availability of health resources and varying emphasis in epidemiologic and laboratory investigation.

IV. IMMUNIZATION STATUS OF POPULATION

A. The 1970 Immunization Survey

Selected results of the September 1970 United States Immunization Survey (USIS) that pertain to poliomyelitis are presented in Tables 16-18. The survey is conducted annually by the Bureau of the Census, in cooperation with CDC. The organizational data were collected by the Bureau through a supplemental questionnaire attached to the monthly current population survey. A sample comprised 35,000 households throughout the United States and included over 100,000 persons.

Table 13
POLIOVIRUS ISOLATIONS
BY REPORTING STATE AND CLINICAL HISTORY, 1970

| State | Type | Associated With Paralytic Disease | | | Nonparalytic | | | Incidental | | |
|--|------|--------------------------------------|------|-----------|--------------------|------|-----------|---------------------|------|-----------|
| | | Vaccine | Wild | Uncertain | Vaccine | Wild | Uncertain | Vaccine | Wild | Uncertain |
| Calif. | 1 | | 2 | 1 | | | | | 1 | |
| | 2 | | | | | | | | | |
| | 3 | | | | | | | | | |
| Colo. | 1 | 1 | | | | | | | | 1 |
| | 2 | | | | | | | 1 | | |
| | 3 | | | | | | | | | |
| Mich. | 1 | | 2 | | | | | | | |
| | 2 | | | | | | | | | |
| | 3 | | | | | | | 1 | | |
| Miss. | 1 | 1 | | | | | | | | |
| | 2 | | 2 | | | | | | | |
| | 3 | | | | | | | | | |
| Mo. | 1 | | | | | | | | | |
| | 2 | 1 | | | | | | | | |
| | 3 | | | | | | | | | |
| N.Y. | 1 | 1 | | | | | | 1 | 1 | |
| | 2 | | | | 1 | | | 1 | | |
| | 3 | | | | | | | 1 | | |
| N.C. | 1 | | | | | 1 | | 1 | 1 | |
| | 2 | | | | | | | 1 | | |
| | 3 | | | | | | | 1 | | 1 |
| Ohio | 1 | 1 | | | | | | | | |
| | 2 | | | | | | | | | |
| | 3 | | | | | | | | | |
| Oreg. | 1 | 1 | | | | | | | | |
| | 2 | | | | | | | | | |
| | 3 | | | 1 | | | | | | |
| Pa. | 1 | | | | | | | | | |
| | 2 | | | | 1 | | | 1 | | |
| | 3 | | | | 1 | | | 1 | | |
| Tex. | 1 | | 14 | 9 | | | 1 | | | |
| | 2 | 3 | | | 2 | | 1 | | | |
| | 3 | | 1 | 1 | | | 1 | | | |
| Wisc. | 1 | | | | | | | | | |
| | 2 | 2 | | 1 | | | | 1 | | 2 |
| | 3 | | | 1 | | | | 1 | | |
| Subtotals | | 11 | 21 | 14 | 5 | 1 | 3 | 12 | 3 | 4 |
| Total Isolations with History of Paralytic Disease | | | 46 | | Total Nonparalytic | | 9 | Total Incidental | | 19 |

Table 14

POLIOVACCINE IMMUNIZATION STATUS*
PERCENT OF POPULATION WITH INDICATED IMMUNIZATION
HISTORY BY AGE GROUP (UNDER 20 YEARS), 1970

| Age Group | Population in 1000's | Adequately Immunized** | | | Total | Partially Immunized | Not Immunized | TOTAL |
|-----------|-------------------------|------------------------|---------------------|----------------------|-------|------------------------|------------------|-------|
| | | 3 OPV and ≥3 IPV | 3 OPV and <3 IPV | >3 OPV and ≥3 IPV | | *** | No OPV or IPV | |
| 1-4 | 14,123 | 6.3% | 49.1% | 10.5% | 65.9% | 23.3% | 10.8% | 100% |
| 5-9 | 20,421 | 20.1% | 47.1% | 15.1% | 82.3% | 14.1% | 3.6% | 100% |
| 10-14 | 20,649 | 31.8% | 36.3% | 17.2% | 85.3% | 11.9% | 2.8% | 100% |
| 15-19 | 18,583 | 29.3% | 30.4% | 18.1% | 77.8% | 17.8% | 4.4% | 100% |

* Source - National Immunization Survey, September 1970

** As defined by Surgeon General's Advisory Committee on Immunization Practices - 3 doses of OPV or 3 or more doses of IPV in acceptable primary series

***Any immunization received not meeting definition of adequate immunization

Table 15
POLIOVACCINE IMMUNIZATION STATUS
IMMUNIZATION HISTORY BY ECONOMIC STATUS AND AGE GROUP
(UNDER 20 YEARS) FOR CITIES WITH POPULATION GREATER
THAN 250,000, AND FOR U. S. AS A WHOLE, 1970*

| I. Cities with greater than 250,000 population | | | | |
|--|-----------|----------------|--------------------------------|--------------------------------------|
| | Age Group | Pop. in 1000's | Percentage** Adequately Immun. | Percentage With No IPV or OPV Immun. |
| <u>Poverty Areas</u> | | | | |
| | 1-4 | 819 | 50.9 | 16.1 |
| | 5-9 | 1,142 | 77.3 | 5.3 |
| | 10-14 | 1,086 | 79.7 | 3.7 |
| | 15-19 | 1,123 | 69.4 | 4.7 |
| <u>Non-poverty Areas</u> | | | | |
| | 1-4 | 2,324 | 63.4 | 9.3 |
| | 5-9 | 3,167 | 81.2 | 3.3 |
| | 10-14 | 3,195 | 82.8 | 3.4 |
| | 15-19 | 2,969 | 75.4 | 4.7 |
| II. U. S. Totals | | | | |
| | 1-4 | 14,123 | 65.9 | 10.8 |
| | 5-9 | 20,421 | 82.3 | 3.6 |
| | 10-14 | 20,649 | 85.3 | 2.8 |
| | 15-19 | 18,583 | 77.8 | 4.4 |

* Source - United States Immunization Survey, September 1970

** According to ACIP Recommendations

Table 16
POLIOVACCINE IMMUNIZATION STATUS*
PERCENTAGE OF POPULATION ADEQUATELY IMMUNIZED AND PERCENTAGE
WITH NO IMMUNIZATION BY AGE GROUPS (UNDER 15 YEARS), 1965-1970

| Age | Percentage Adequately Immunized** | | | Percentage with No OPV or IPV Immunization | | |
|------|-----------------------------------|------|-------|--|-----|-------|
| | 1-4 | 5-9 | 10-14 | 1-4 | 5-9 | 10-14 |
| 1965 | 73.9 | 89.9 | 92.1 | 9.9 | 3.0 | 2.1 |
| 1966 | 70.2 | 88.2 | 90.0 | 11.3 | 2.9 | 2.3 |
| 1967 | 70.9 | 88.3 | 89.7 | 11.7 | 3.1 | 2.2 |
| 1968 | 68.3 | 84.9 | 87.8 | 10.5 | 3.3 | 2.2 |
| 1969 | 67.7 | 83.6 | 85.7 | 10.2 | 3.2 | 2.5 |
| 1970 | 65.9 | 82.3 | 85.3 | 10.8 | 3.6 | 2.8 |

*Source - United States Immunization Survey, September 1970

**As defined by Advisory Committee on Immunization Practices - 3 doses of OPV or 3 or more doses of IPV in an acceptable primary series

More detailed data describing this project and further describing immunization levels for poliomyelitis are reported elsewhere (1). The percentage of the population with selected immunization histories are shown by age group in Table 14.

For cities with a population of 250,000 or more, poverty areas were determined by ranking census tracts according to the relative presence of each of the five equally-weighted characteristics. These five characteristics included the following:

1. Percent of families with incomes under \$3000.
2. Percent of children under 18 years of age not living with both parents.
3. Percent of persons 25 years of age and over with less than 8 years of school.

4. Percent of unskilled males in the employed civilian labor force.

5. Percent of housing units delapidated or lacking some or all plumbing facilities.

The polio immunization status, by economic status and age, for cities with populations over 250,000 and for the United States as a whole appears in Table 15. The data show that in the poverty areas in these cities levels of immunity to poliomyelitis were particularly low, while levels in nonpoverty areas of the cities generally corresponded with national levels.

Age specific immunization survey results for the past 6 years regarding percentage of the population under 15 years adequately immunized against poliomyelitis, and percent with no immunization, are presented in Table 16. Generally a decline in percentage of population adequately immunized occurred over this period in each age group, although the percentage with no immunization has remained relatively stable for the 6-year period.

RECOMMENDATION OF THE PUBLIC HEALTH SERVICE ADVISORY COMMITTEE ON IMMUNIZATION PRACTICES POLIOMYELITIS VACCINES

INTRODUCTION

Widespread use of poliovirus vaccines since 1955 has resulted in the virtual elimination of paralytic poliomyelitis in the United States. To ensure continued freedom from the disease, it is necessary to pursue regular immunization of all children from early infancy.

Paralytic poliomyelitis declined from 18,308 cases in 1954 to 40 cases in 1967 and 48 cases in 1968. A national survey in 1968 showed that 82 percent of individuals 1-19 years old had received at least three doses of oral poliovirus vaccine (OPV)*, inactivated poliovirus vaccine (IPV)**, or both.

Nevertheless, low immunization rates still prevail in certain disadvantaged urban and rural groups, particularly for infants and young children born since the mass immunization campaigns conducted between 1958 and 1962. Most of the cases of paralytic poliomyelitis in recent years occurred in these populations.

With widespread use of poliovirus vaccine, laboratory surveillance of enteroviruses indicates that circulation of wild polioviruses has diminished markedly. It can be assumed that inapparent infections with wild strains will no longer contribute significantly to maintaining immunity; therefore, it is essential not only to continue active immunization programs for infants and children but also to make special efforts to raise the low immunization rates existing in certain other segments of the population. Population groups requiring immunization can be identified by immunization history and serologic survey.

POLIOVIRUS VACCINES

Between 1955, when IPV was introduced, and 1962, when live, attenuated vaccines became widely used, more than 400 million doses of IPV were distributed in the United States. Primary immunization with IPV plus regular booster doses provided a high degree of protection against paralytic disease.

OPV has largely replaced IPV in this country because it is easier to administer, requires no boosters, and produces an immune response like that induced by natural poliovirus infection.

Monovalent OPV types 1, 2, and 3 were widely used in the United States beginning in 1961, but they have

* Official names of the products in use: (1) Poliovirus Vaccine, Live Oral, Type 1, (2) Poliovirus Vaccine, Live, Oral, Type 2, (3) Poliovirus Vaccine, Live Oral, Type 3, (4) Poliovirus Vaccine, Live, Oral Trivalent.

** Official name: Poliomyelitis Vaccine.

generally been supplanted by trivalent OPV because of greater simplicity in scheduling and recordkeeping.

A primary series of three adequately spaced doses of trivalent OPV will produce an immune response to the three poliovirus types in well over 90 percent of recipients.

Very rarely, paralysis has occurred in recipients of OPV or in their close contacts within 2 months of vaccine administration. Currently, for each 9 million doses of OPV given, no more than one case of "vaccine associated" paralysis in recipients and two in recipient contacts are reported.

VACCINE USAGE

Trivalent OPV—Primary Immunization

Infants: The three-dose immunization series should be started at 6 to 12 weeks of age, commonly with the first dose of DTP. The second dose should be given not less than 6 and preferably 8 weeks later. The third dose is an integral part of primary immunization and should be administered 8 to 12 months after the second dose.

Children and adolescents: For unimmunized children and adolescents through high school age, the primary series is three doses. The first two should be given 6 to 8 weeks apart, and the third, 8 to 12 months after the second. If circumstances do not permit the optimal interval between the second and third doses, the third may be given as early as 6 weeks after the second.

Adults: Routine poliomyelitis immunization for adults residing in the continental United States is not necessary because of the extreme unlikelihood of exposure. However, an unimmunized adult at increased risk through contact with a known case or travel to areas where polio is epidemic or occurs regularly should receive trivalent OPV as indicated for children and adolescents. Persons employed in hospitals, medical laboratories, and sanitation facilities might also be at increased risk, especially if poliomyelitis is occurring in the area.

Pregnancy is not an indication for vaccine administration, nor is it a contraindication when protection is required.

Monovalent OPV—Primary Immunization

An alternative primary immunization is one dose of each of the three types of **monovalent** OPV given at 6 to 8 week intervals, with a dose of **trivalent** OPV given 8 to 12 months after the third dose of monovalent OPV to ensure adequate responses.

OPV—Booster Doses

Entering school: On entering kindergarten or first grade, all children who have completed the primary series of OPV should be given a single dose of trivalent OPV; others should complete the primary series.

There is no indication for routine booster doses of OPV beyond that given at the time of entering school.

Increased risk: A single dose of trivalent OPV can be administered to anyone who has completed the full primary series because of travel or occupational hazard as described above. The need for such an additional dose has not been established, but if there is uncertainty about the adequacy of existing protection, a single dose of trivalent OPV should be given.

Contraindications

Altered immune states: Infection with live, attenuated polioviruses might be potentiated by severe underlying diseases, such as leukemia, lymphoma, or generalized malignancy, or by lowered resistance, such as from therapy with steroids, alkylating drugs, antimetabolites, or radiation; therefore, vaccination of such patients should be avoided.

IPV—Primary Immunization

All ages: Four parenteral doses should be given, three at approximately 1-month intervals and the fourth 6 to 12 months after the third. This schedule can be integrated with DTP immunization beginning at 6 to 12 weeks of age.

IPV—Booster Doses

A booster dose every 2 to 3 years is generally recommended to ensure adequate levels of antibody. The need for IPV boosters could be obviated by a full course of OPV. For individuals at particular risk, as described previously, at least one dose of trivalent OPV, but preferably a full primary series, is recommended.

EPIDEMIC CONTROL

For operational purposes in the United States, an "epidemic" of poliomyelitis is defined as two or more cases caused by the same poliovirus type and occurring within a 4-week period in a circumscribed population, such as that of a city, county, or a metropolitan area. An epidemic can be controlled with either trivalent OPV, or, after identification of the responsible type of poliovirus, homotypic monovalent OPV. Within the epidemic area, all persons over 6 weeks of age who have not been completely immunized or whose immunization status is unknown should promptly receive OPV.

SIMULTANEOUS ADMINISTRATION OF LIVE VIRUS VACCINES

There are obvious practical advantages to administering two or more live virus vaccines simultaneously. Data from specific investigations are not yet sufficient to develop comprehensive recommendations on simultaneous use, but a summary of current experience, attitudes, and practices provides useful guidance.

It has been generally recommended that live virus vaccines be given at least 1 month apart whenever possible — the rationale for this being that more frequent and severe adverse reactions as well as diminished antibody responses otherwise might result. Field observations indicate, however, that with simultaneous administration of certain live virus vaccines, results of this type have been minimal or absent. (For example, the third dose of trivalent oral poliovirus vaccine, which is recommended during the second year of life, is commonly given at the same time as smallpox vaccination without evident disadvantage.)

If the theoretically desirable 1-month interval is not feasible, as with the threat of concurrent exposures or disruption of immunization programs, the vaccines should preferably be given on the same day — at different sites for parenteral products. An interval of about 2 days to 2 weeks should be avoided because interference between the vaccine viruses is most likely then.

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Key to all disease surveillance activities are the physicians who serve as State epidemiologists. They are responsible for collecting, interpreting, and transmitting data and epidemiological information from their individual States; their contributions to this report are gratefully acknowledged. In addition, valuable contributions are made by State Laboratory Directors; we are indebted to them for their valuable support.

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